

Radiation Physics and X-ray machine

1-Electromagnetic radiation is classified into ionizing and non-ionizing radiation, only the cosmic rays, gamma rays and x-rays are capable of ionization.

2-Electromagnetic radiations have no mass or weight or electrical charge, travels in waves, propagate with electrical and magnetic fields perpendicular to each other and to its path.

3- Characteristics of x-rays are penetrability (increasing the penetrability is associated with x-rays of increasing frequencies and photon energies and decreasing wavelength), Fluorescent effect, initiate biological changes and have extremely short wavelength.

4- The cathode of x-ray machine is a tungsten wire filament (the source of electrons) is set in a metal cup which helps to focus the electron onto the tungsten target (focal spot of the anode).

5- The target (focal spot) made of a tungsten button, designed with angulation "17 degrees" which make it possible to have an effective focal spot size $\frac{1}{4}$ or more compared to the actual focal spot size.

6- Having a maximum actual focal spot size makes the target withstand heat and increases the work and load capacity & having an effective focal spot of minimum size increases the radiographic details through a decrease in geometric unsharpness.

7- Heat dissipation is done by copper head and copper arm which extends to the outer insulating oil.

8- Aluminum filter removes the low energy, less penetrating and longer wavelength photons that are absorbed by the skin and never reach the film to record the image.

9- Collimator is responsible for restriction of the beam size so reduces the exposure of the patient to unnecessary radiation and producing a better contrasted image by reducing the amount of scatter radiation produced by tissue irradiated.

10- Rectangular collimator restricts the beam size to a size which is slightly larger than size 2 dental x-ray film while the circular one produce a cone-shaped beam larger than size 2 film.

11- The cone (position indicating device) is used for determining the point of entry and fixing target film distance.

Image Characteristics

1- types of x-rays

(breking radiation - characteristic radiation)

2- energy of x ray is heterogenous ?

(2 breking radiations - 2 characteristic radiation)

3- 99 % of x-ray E is heat

4- filter is from aluminium → remove soft rays

5- collimator is from lead → control beam size “ radius “

6- cone cut : part of x-ray film un exposed to x-ray

7- mA limits is (8 : 12) mA

8- if short cone density = long cone density so ,

Exposure time of short cone → 1 s

Exposure time of long cone → 48 s

9- bad properties of scattered radiation :

Low penetration power

Different direction

10- factor affecting density

Factors relating to machine “ beam modifiers “

Factors relating to object “ density & thickness “

Factor relating to film “ grain size & shape - emulsion coat - iodine “

Factor relating to “ processing

Dental x-ray film

1- Dental film is composed of 4 basic components which are film base, adhesive layer, emulsion layer, protective layer.

2- The film base acts as a support for the emulsion and should be translucent, dimensionally stable and withstand heat moisture and chemicals.

3- The adhesive layer serves in attaching the emulsion to the base.

4-Emulsion layer is a sensitive coating to x-rays and light, may be on one side (single coated) or both sides (double coated) of the base by the adhesive layer.

5- Emulsion layer is a homogenous mixture of gelatin (used to suspend and disperse the Ag halide crystals over the film base) and Ag halide crystals (absorb energy from radiation during exposure and store it in the form of latent image).

6- Protective layer is responsible for protection of the film surface from mechanical damage during processing or handling.

7- The latent image is an invisible image within the emulsion on the exposed film created by the pattern that formed from the stored energy in the crystals.

8- Dental film types according to the position are intra oral films and extra oral films.

9- Intra oral films (non screened films) types according to their uses are periapical (shows the tip of the tooth and the surrounding structures together with the crown), bitewing (used to examine the crowns of upper and lower teeth on one film, interproximal caries and crestal alveolar bone resorption) and occlusal (used to localize the salivary gland stones, impacted teeth, supernumerary and fractures).

10- Intra oral films are manufactured in five sizes (0,1,2,3,4,5) size 0,1,2 (the standard) are used in periapical film , size 3 is used in bitewing film while size 4 is used in occlusal film.

11- Intra oral film speed (sensitivity) determines how much radiation or exposure time is necessary to produce a standard image on the film.

12- Factors affecting the film speed are coating of film (double coated is more sensitive but lead to unsharpness), size of the crystals (increased size crystal is more sensitive but lead to unsharpness), shape of the crystals (tabular is more sensitive but lead to unsharpness) and presence of special radiosensitive dyes.

13- The double coated film will show decreased sharpness because these double coats aren't identically coated and the x-rays are diverging and there is a double coat so there will be slight variation in the size of each image recorded on each emulsion (parallax).

14- Convenient plastic packet is better than cardboard one as the cardboard packet may be contaminated by saliva and this saliva leakage will lead to powerful attachment between the black paper and the film so it will lead to tearing and scratching of the emulsion layer when removal of black paper away of the film during processing i.e. image distortion.

15- The film packet has an embossed dot on one corner that is used to help in orientation, the side of the film on which the dot is raised is always placed towards the x-ray beam (towards the incisal in anterior and occlusal in posterior)

16- There is a pattern placed on the lead foil sheet that present in the back of the intra oral film packet, this pattern will be visible on the processed radiograph if the film packet is placed incorrectly as the back side of the packet is facing towards the x-ray beam.

17- The Extra oral film (screen film) is designed to be sensitive to light more than x-rays because it's placed between two intensifying screens in a film-screen holder termed as a cassette.

18- The disadvantage of the intensifying screen is unsharpness of the image due to diffusion of light in different directions so this diffusion of light can be minimized by assuring intimate contact between the screen and the film achieved by enclosing the film between 2 screens in a cassette holder which has a felt padding to assure this intimate contact.

19- Intensifying screen types are conventional calcium tungstate screens (emit the blue light) and rare earth type (emit green light).

Processing

- 1- Latent image consists of three types of crystals: totally ionized, partially ionized & unexposed crystals.**
- 2- The unit of affection of the processing solutions is the whole crystal while the unit of affection of x-rays is the Ag halide molecule.**
- 3- There are 2 main components of any processing solution which are developer and fixer.**
- 4-The developer removes bromide from the ionized molecules only because of the presence of the Ag specks which act as a catalyst or a bridge for the developer to enter the ionized crystals (either totally or partially) and remove the bromide leaving black metallic Ag.**
- 5-The fixer act mainly to fix the precipitated black metallic Ag in place and to clear away all the unexposed crystals of Ag halides leaving clear white areas.**
- 6- Developer chemically composed of 4 components which are developing agents (reduce the exposed Ag halides to black metallic Ag), preservative (protects the developers from oxidation), activator (provide an alkaline medium for activation of developers) & restrainer (restrain development of unexposed Ag halide crystals i.e. acts as antifog agents).**

7- Fixer chemically composed of 4 components which are clearing agent (dissolve and remove the unexposed Ag halide), preservative (prevents oxidation of the clearing agent), acidifier (keep the fixer PH constant) &hardener (prevent damage of the gelatin by hardening it).

8- Processing room should be at least 4 inches (feet), near to operating rooms and should have safe light without any source of fluorescent light to avoid its afterglow, manual processing tank, timer, thermometer, dryer and film hangers.

9- Blank image could be produced by making fixation before developing during processing and also by putting the backside of the extra oral film towards the tube during exposure.

Intra oral techniques

1- types of periapical radiography :

(parallel technique - bisecting technique)

2-indication of periapical tech :

(periapical infection _ recurrent caries _ endodontic treatment)

3- advantage of film holder :

(not exposing patient finger _ dimension accurate)

4- advantages of parallel tech :

(dimension accurate _ easy _ standard _ decrease of superimposition)

5- disadvantages of parallel tech :

(less comfortable - limited by anatomy)

6- advantages of bisecting tech :

(more comfortable - easy - no anatomical restriction -)

7- disadvantages of bisecting tech :

(no parallelism - less stable - not exposing patient finger)

8- indication of bite wing tech :

(proximal caries - detection of overhanging restoration - pulp stone)

**9 - indication of occlusal tech :
(large lesion - buccolingual lesion - trismus)**